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# PSYCHE

Vol. 64 March, 1957 No. 1

## NOTES ON THE ANT *LEPTOTHORAX PROVANCHERI* EMERY

By Paul B. Kannowski

Department of Biology
University of North Dakota

The ant, *Leptothorax provancheri* Emery (= *L. emersoni* Wheeler, *L. e. glacialis* Wheeler, and *L. e. hirtipilis* Wheeler), is interesting because of its peculiar habits, rare occurrence, and unusual distribution. It has long been known as an inquiline in the nests of *Myrmica brevinodis* Emery, and, until recently, it was thought that this relationship was obligatory on the part of *provancheri.* Cole (1954, p. 241) indicates that this species is able to live independently (under stones), at least in the mountains of New Mexico. The habits of *provancheri* were first noted by Wheeler (1901). He had discovered that its nests were intimately connected with the galleries and chambers of *Myrmica brevinodis* nests. In this and a later paper (1903a) on *provancheri,* Wheeler presented an interesting and detailed analysis of the symbiotic relationship between *provancheri* and its host.

Wheeler stated that the nests of these two ants were found in the Litchfield Hills near Colebrook, Connecticut, "under some small stones that were rather deeply imbedded in the moss bordering the exposed glaciated rock of the hilltop" (1901, p. 432). The habitat of *provancheri* was later expanded by Wheeler (1903b, p. 231) to include nests with *M. brevinodis* "in the hummocks of moss (*Polytrichum commune*), under stones, bits of wood, etc., in rather damp, grassy bogs."

The ants of three sphagnum bogs in Livingston and Washtenaw counties, Michigan, have been under study for the last four years. The occurrence of several species

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of *Myrmica* in various plant communities of the bog sere has been noted, including *M. brevinodis* and *M. fracticornis* Emery. In spite of intensive observations on approximately 300 *Myrmica* colonies, no nests of *provancheri* have been found.

On the morning of July 22, 1955, several hours were spent in Mud Lake Bog, Section 7, Munro Township, Cheboygan County, Michigan, searching for nests of *M. fracticornis*. Colonies were found in an immature leatherleaf community, which was characterized by a continuous sphagnum surface and numerous small clumps of shrubs and small trees, composed largely of leatherleaf, highbush blueberry, black spruce, and tamarack. The remains of some dead coniferous trees indicate that this is probably a disclimax community produced by a fire sometime within the last twenty years.

The hummocks of moss at the base of the south edge of a clump of the trees and shrubs named above contained a populous colony of *fracticornis*. While this nest was being sampled, several workers of *provancheri* were discovered moving about the galleries and chambers of the nest. Seven *provancheri* workers were collected and kept alive with a small portion of the *fracticornis* colony. Other workers of *provancheri* were carefully watched in order to find the location of their nest. These workers were soon lost, and their nest was not located. Most likely it was somewhere on the periphery of the *fracticornis* nest, and it may have been destroyed or displaced during collecting.

Smith (1951, pp. 821-822) cites records for *provancheri* and its synonyms from four New England States, Colorado, and Alberta, Canada, and it also occurs in North Dakota (Kannowski, 1956). The present record is the first from Michigan and, together with the North Dakota locality, ties together a previously discontinuous distribution. Cole's record from New Mexico is the only extension to the geographic range of this ant given by Creighton (1950, pp. 279-280). The range of *provancheri* is blanketed by the ranges of both of its known host species (see Creighton, *op. cit.*, pp. 96 and 100). Therefore, *provancheri* could

have a much more extensive range than that which is presently known. The rarity and limited distribution of this species seem to be due to three factors: 1) very few areas within its hypothetical range have been studied intensively; 2) *provancheri* workers may easily be overlooked because of their small size and relatively few numbers (in comparison with the numbers of the host species); 3) because of environmental factors, its range is more restricted than that of its hosts.

The apparent absence of *provancheri* in bogs in southeastern Michigan indicates that the factors governing its distribution are different from those governing the distribution of the two host species. The bogs that have been studied in Livingston, Washtenaw, and Cheboygan counties are composed of similar plant communities, and the edaphic conditions are similar. Climatic conditions seem similar except for the extremes of temperature found in the two regions. Summer temperatures in southeastern Michigan are higher than those of Cheboygan County, and these high temperatures occur for longer periods of time. The temperatures in southeastern Michigan may be too high for the proper development of *provancheri* colonies, although this factor may not be critical in the case of the two species of *Myrmica*. The presently known range of *provancheri* strongly suggests an adaptation to regions of cool temperatures.

*Myrmica fracticornis* has not previously been recorded as the host of any inquilinous ant, probably as the result of insufficient study of ants in the moist environments of northeastern North America. Additional records should turn up in the future. It also seems probable that other species of *Myrmica* may be found as hosts of *provancheri*.

Seven *provancheri* workers were kept for about two months in an artificial nest with a small fragment of the *fracticornis* colony, including one queen, four alate females, three males, about 50 workers, and a small quantity of larvae and pupae. Random observations of the mixed nest during this time showed that the *provancheri* workers were accepted by the *fracticornis* colony; no evidence of hostility between the two groups was ever observed. The two

groups utilized separate areas for nest sites, but each permitted the other within its own area. The *provancheri* workers were seen to "shampoo" the backs and heads of *fracticornis* workers and females and to receive regurgitated food in return just as Wheeler (1901) had observed to occur between *provancheri* and *brevinodis*. The *provancheri* and *fracticornis* workers were also observed feeding together on honey, syrup, and water that was placed in the chambers, but only the *fracticornis* workers were seen to feed upon the bodies of freshly killed insects (roaches, flies, lacewing-flies, and collembolans) that were also introduced into the nest.

From the above observations it seems evident that *provancheri* is in an early stage of social parasitism as indicated by its ability to live independently in part of its range, whereas in other parts it requires the presence of *Myrmica* nests. In those areas where it lives as an inquiline it is also probable that the colony-founding female seeks first a suitable environment (one that is both moist and cool), and, once there, seeks a *Myrmica* nest. In Michigan bogs the choice of *Myrmica* nests in the open mat zone is largely restricted to *brevinodis* and *fracticornis*.[1] In other areas (North Dakota, for instance) *Myrmica brevispinosa* Wheeler may occur in the same or similar environments as those occupied by *brevinodis* and *fracticornis*. The rarity of *provancheri* and *fracticornis* combinations may indicate that *fracticornis* tolerates the inquilines less frequently than *brevinodis* does. The similarity of the behavior of *fracticornis* and *brevinodis* in response to the "shampooing" by the *provancheri* workers suggests that this behavior pattern may be common to other more closely related species of *Myrmica*.

[1] A third species of *Myrmica* of uncertain identity is also present in southeastern Michigan bogs.

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The Army Ant Aenictus exiguus Clark a Synonym. The description and figure of *Aenictus exiguus* Clark, 1934, Mem. Nat. Mus. Vict., Melbourne, 8:21, pl. 2, fig. 1, worker (type loc.: Cairns district, northern Queensland) agree well enough with samples from Queensland, New South Wales, and New Guinea of *Aenictus turneri* Forel, 1900, Ann. Soc. Ent. Belg., 44: 75, worker (type loc.: Mackay, Queensland), except for the low measurement ("1.7 mm.") given by Clark for his types. This measurement, like others that have been checked from Clark's ant descriptions, appears to be excessively small, even for such a size-variable species as *turneri*. Particular similarities in the critical characters of head and mandible form, and shape of propodeum and ventral process of petiole, all indicate that *Ae. exiguus* must be considered a **new synonym** of *Ae. turneri*. Brown, 1952, Psyche, 58: 123, had already placed *Ae. deuqueti* Crawley as a synonym of *Ae. turneri* after examining type material. — W. L. Brown, Jr., Museum of Comparative Zoology.

# FURTHER NOTES ON THE GENUS *EREMOLEON* BANKS, WITH A NEW SPECIES (NEUROPTERA: MYRMELEONTIDAE)[1]

By Phillip A. Adams
Biological Laboratories, Harvard University

The material described below was not seen by the writer in time for inclusion in the list of species of *Eremoleon* given in a previous paper (Psyche 63: 82-108, 1957).

*Eremoleon cerverinus* (Navas) **new comb.**
Figure 1 a, b, c

*Belen cerverinus* Navas, 1921, Broteria 19:119 (Genotype *Belen* Navas 1921).

A small species, somewhat like *E. macer* in appearance. Antennal segments all broader than long. Vertex and pronotum as in fig. 1a. Setae on head and thorax all white, on legs, mostly black. Apical segment of fore tarsus approximately as long as four preceding segments, cylindrical, with ventral setae evenly spaced. Mesepimeral wing process light brown.

Abdominal tergite 2 dark, 3-7 pale basally, apical halves black. Paramere plates rhomboidal, sculptured area not extending over entire surface of plate (fig. 1b).

Wings slender. Fore wing with 9-11 veinlets from $PCu+A_1$ to hind margin; in holotype 4-5, prestigmatic costal veinlets connected. Cubital field of hind wing with three rows of cells. Venation mostly pale, many cross veins dark; small brown spots at rhegma and base of stigma.

Measurements (mm.): fore wing 24. long, 6.2 wide; hing wing 23. (♂) — 23.5 (type) long, 5.0 wide; antennae 4.2 (type); 3rd abdominal tergite 3.0 (♂).

The holotype (No. 15125) and a ♂ from Rio Almendares, Habana, Cuba, Cervera col., are in the Museum of

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

Comparative Zoology. To the type has been affixed a ♀ abdomen from a specimen of another species.

*E. macer* may be differentiated from *cerverinus* by its more slender labial palpi, and by its having a swelling, bearing a dense brush of setae, on the ventral side of the apical tarsomere. *E. pallens* has nó distinct vertex markings, has black setae on the pronotum, and four rows of cells in the cubital area of the hind wing.

The character upon which Navas based his genus *Belen,* anastomosis of several prestigmatic cross veins, is present in the holotype, but not in the male. There being no other character of generic significance separating *cerverinus* from the other species of *Eremoleon, Belen* must be considered a synonym of that genus.

**Eremoleon sectoralis**, new species

Figure 1 d, e

Lower face and mouthparts pale, frons and vertex fuscous. Vertex scars brown-suffused; pattern like that of *cerverinus* (fig. 1a), but two lateral spots of second vertex row are fused. Scape shiny brown, pedicel brown above. Palpi (fig. 1e) slender. Thorax brown-fumose above, pale yellow below, no distinct macular pattern. Mesepimeral wing process honey-yellow. Legs pale, brown-dotted at setal bases; brown bands at apex of femur, near base and at apex of tibia, and at tip of last tarsomere. Fore tibial spurs equal 3½ tarsomeres in length, hind spurs, 2½ tarsomeres. Apical segment of fore tarsus cylindrical, length 0.37 times that of entire tarsus. Abdomen brown-fuscous, without distinct markings; 2nd and base of 3rd sternite, and segments 7-10, pale.

Setae mostly dark, except some pale on frons, clypeus, cervical sclerites, meso- and metapleurae, base of fore coxa, and 2nd and 3rd abdominal sternites. Pronotal setae shorter than those of *cerverinus,* and more numerous behind furrow. Setae on apex of 9th abdominal tergite, and posteroventral portion of 10th, short (less than 0.14 mm. long), black, stout, decumbent; tips flattened, expanded, blunt.

Wings (fig. 1d). Basal costal veinlets widely spaced; cross veins absent from first few branches of Rs. Venation

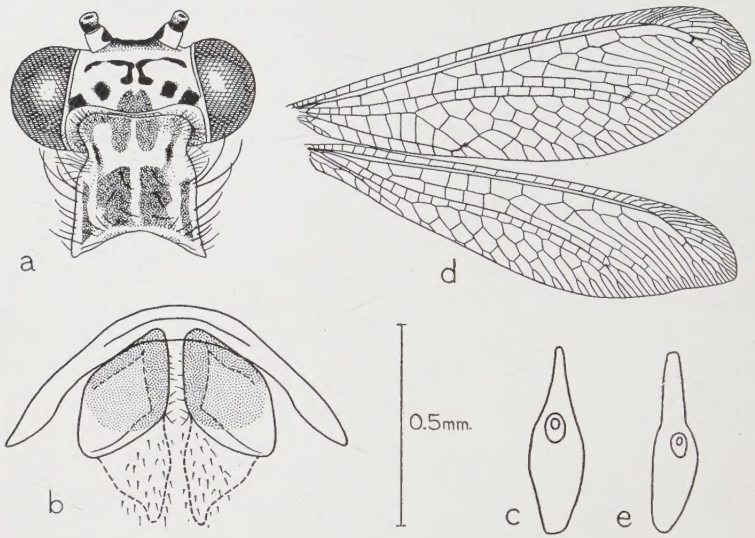



Fig. 1. *Eremoleon cerverinus* (Navas): a — vertex and pronotum, b — gonarcus and parameres, c — last segment, labial palpus. *E. sectoralis* n. sp.: d — wings, e — last segment, labial palpus. Scale for figs. b, c, e only.

mostly brown, some pale streaks along main veins of fore wing and C, Sc and R in hind wing. Faint brown spots at stigma, apex of hypostigmatic cell, rhegma, and end of $CuA_2$ in fore wing, at rhegma in hind wing.

Measurements (mm.): body length, 22.; abdomen 16.5; fore wing length 23.; pterothorax 3.9; 3rd abdominal tergite 3.6.

Holoytpe ♀: 5 mi. S. San Miguel, L. Calif., 20-VII-38, Michelbacher and Ross, in the California Academy of Sciences. This specimen is a paratype of *E. affine* Banks (= *E. nigribasis* Banks).

The wing shape and lack of cross veins between the first few branches of Rs are characteristic of this species. *Sectoralis* resembles *E. pallens* Banks, which differs in having broader, pointed wings, with 4 rows of cells in cubital field of hind wing, pale pedicel and scape, no dark dots on legs, and long (up to 0.36 mm.), pointed, straight setae on 9th abdominal tergite of ♀.

# DESCRIPTIONS AND RECORDS OF NEOTROPICAL CONOPIDAE (DIPTERA)

By Sidney Camras
Chicago, Illinóis

The first part of this paper may be considered an addendum to my work on New World *Conops* and allies (1955, Proc. U.S. Nat. Mus., **105**, 155-187). A number of other apparently new forms have been seen; but I am awaiting more material, or the opportunity for a revisional study in the case of *Zodion*.

**Diconops**, subgen. nov.

Belonging to the genus *Conops*, but having a relatively long and narrow second abdominal segment. Second abdominal segment (female) dorsally, about three times as long as wide, sides parallel. Third segment about three-fourths as long as second, apex nearly two times as wide as base. One propleural bristle on the type species, none on the other species. Posterior margin of eye more concave than usual. Polished triangular area at posterior margin of eye nearly absent.

Type: *Conops trichus*, sp. nov.

This subgenus could be placed in *Physoconops*, as a group lacking the ocellar tubercle; but I consider the absence of the ocellar tubercle more characteristic of the genus *Conops* than the wide abdomen.

The male is as yet unknown.

**Conops (Diconops) trichus**, sp. nov.

Holotype ♀: Brazil: Nova Teutonia, Santa Catarina, Nov. 1952, F. Plaumann (author's collection).

Vertex yellow, rounded anteriorly, black laterally. Front yellow with black "T" pattern. Face and upper grooves yellow. Lower face and grooves, and cheeks black. Facial grooves and orbital yellow pollinose. Occiput black. Anten-

na mainly black. Reddish yellow on third segment medially and on the first segment. First antennal segment four times as long as wide. Second segment nearly twice as long as first. Third segment about three-fourths as long as second. Arista three segmented, without lateral process on the second segment. Proboscis nearly twice as long as head; black, with yellow on apical ventral half.

Thorax black. Gold pollinose faintly on dorsum, with distinct areas medial to the humeri, at base of wings, and at the scutellum. Pleura with distinct yellow pollinose stripe. Legs brownish yellow, partly black on coxae, apical tarsal segments, and most of claws. Wings yellowish hyaline, with brownish yellow pattern between first vein and third vein and vena spuria. Yellow in costal, subcostal, and first basal cells. Calypters and halteres brownish yellow.

Abdomen black, yellow at fused junction of second and third segments. Apical margin of third segment, fourth, fifth, and sixth segments yellow pollinose, more distinct at distal margin. The hairs on the third to sixth segments more distinct than usual. Theca and genital segments shining black. Subapical genital segment mainly reddish. Theca as long as wide, and relatively thin.

Size: 14½ mm. (without antenna).

Paratype ♀: same data, Dec. 1952.

Similar to the holotype. Posterior femora darker at basal half. Theca yellowish anteriorly.

Size: 15½ mm.

This species keys to *Physoconops gracilior* (Camras, 1955, Proc. U. S. N. M., **105**:186) but differs in the color of the vertex, facial grooves, cheeks, etc., in addition to the generic difference.

**Conops (Diconops) geminatus**, sp. nov.

Holotype ♀: Peru: Monson Valley, Tingo Maria, Dec. 11, 1954, E. I. Schlinger and E. S. Ross (California Academy of Sciences, San Francisco).

Vertex yellow, black on each side forming a velvety black triangular mark on each side of the front with the black "T" pattern of the front. Remainder of front, face,

and upper facial grooves yellow. Cheeks and remainder of facial grooves black. Facial grooves, orbitals and interrupted post-vertical stripe gold pollinose. Occiput black. Antenna black. First antennal segment four times as long as wide. Second segment nearly two times as long as first. Third segment one and one-half times length of first. Arista three segmented. Lateral process on second segment indistinct. Proboscis two times length of head, black with yellow on about distal ventral half.

Thorax black, with considerable gold pollen on dorsum covering it completely in certain views. In other views, there are three black stripes on the dorsum. A distinct gold pollinose pleural stripe is connected with the gold pollen of the dorsum. Legs yellow; blackish partly on coxae, base of hind femora, tarsi, except base of first tarsus, and claws. Wings hyaline, brownish pattern between costa, and third vein and vena spura. The dark pattern in the first posterior cell is confined to less than the anterior half. Calypters dark yellow. Halteres bright lemon yellow, brown at base of stem.

Abdomen black, yellowish at junction of second and third segments. Gold pollinose at junction of first and second, second and third, and distal margins of remaining segments. Fifth, sixth, and base of seventh segments gold pollinose. Genital segments and theca dark reddish yellow. Theca as long as wide.

Size: 8½ mm. (without antenna).

This species is similar to *trichus* but differs mainly in the color of the front, thorax, and wings. Although very different in appearance, they are probably geographical representatives. This species keys to *Physoconops antennatus* (Camras, 1955, Proc. U. S. N. M. **105**:186) but differs in generic and color characters.

*Physoconops parsonsi* Camras

**1955, Proc. U. S. Nat. Mus., 105, 171.**

The types of this species had been erroneously placed in the U.S. National Museum Collection. P. J. Darlington, Jr., called our attention to this, and the types have been returned to the Museum of Comparative Zoology.

*Physoconops pictus* (Fabricius)

In the above mentioned paper (p. 166), the specimens from Havana, Cuba, and Manneville, Haiti, recorded from the U.S. National Museum, likewise belonged to the Museum of Comparative Zoology, and have been returned to that collection.

*Physoconops* (*Shannonoconops*) *apicalis* Camras

1955, Proc. U.S. Nat. Mus. **105**, 172.

This distinctive form was described from a male from Mato Grosso, Brazil, and a female from Peru. Since then, I have received a male and a female from Nova Teutonia, Santa Catarina, Brazil, collected by F. Plaumann.

*Physoconops analis* (Fabricius)

This name replaces *Physoconops angustifrons* (Williston) in my review (1955, Proc. U.S. Nat. Mus. **105**, 178). This important change of names has been made in my paper on New World *Physocephala* (1957, Ann. Ent. Soc. Am. **50**, 217), but is repeated here as it is apt to be overlooked.

**Zodion rossi**, sp. nov.

Holotype ♂: Mexico: San Luis Potosi; 40-50 miles N. W. C. del Maiz, Nov. 20, 1948, E. S. Ross (California Academy of Sciences, San Francisco).

Head pale yellow. Sides of upper front and vertex dark reddish. Center of ocellar tubercle black. Upper occiput blackish, lower occiput yellow. Antenna deep yellow, somewhat orange on third segment. First segment very short, shorter than wide. Third segment slightly longer than second. Arista black. Proboscis one and one-half times length of head; black, brownish at base. Palpi slightly longer than width of proboscis at base.

Thorax yellow. Dorsum black with grayish yellow pollinose submedian and sublateral lines. These lines joining posteriorly. The sublateral line is interrupted in the middle by the transverse suture. Humeri, light yellow. Scutellum deeper yellow, with a large tuft of black hairs on each side. Apical margin of scutellum slightly concave.

Pleura mainly yellow. Sternopleura mainly black. Legs mainly yellow, dark reddish distally and dorsally on the femora. Tibiae more yellowish in the middle. Apical tarsi and apical half of claws black. Wings hyaline, yellow at base. First posterior cell long petiolate. Calypters light yellow. Halteres light yellow, dark reddish at base.

Abdomen mainly deep yellow with paler yellow distal margins. Blackish red on first, basal two-thirds of second, about basal one-half of third, and basal centers of fourth and fifth segments. Sides of second and third segments yellow. Genital segments darker yellow.

Size: 5 mm.

Allotype ♀: Same data.

Similiar to the holotype. Dorsal third of front and vertex rufous. Abdomen more predominantly dark rufous on most of the segments dorsally, yellow laterally and on distal margins. Median longitudinal yellow band on fifth, sixth and seventh segments. Genital segments black. Theca apparently as long as wide. Size: 5½ mm.

Paratype ♂: Same data. (Retained in author's collection).

Similiar to the holotype, but somewhat more rufous on vertex and abdomen. Size: 4½ mm.

This very distinctive form differs structurally from the other species of *Zodion* in the scutellum and wing venation, and could be placed in a separate subgenus.

**Scatoccemyia**, gen. nov.

Similar to *Occemyia* but having a markedly thickened anterior cross vein, shorter, thicker antenna, more quadrate shaped head, a fronto-facial black mark, more prominant rows of bristles on ventral surface of femora, more pollinose (less shiny black) coloration, and more hairy appearance.

Type: *Scatoccemyia plaumanni,* sp. nov.

This genus resembles a Scatophagid. Since the genus *Occemyia* has not been found in South America as yet, this genus may be replacing it on that continent.

**Scatoccemyia plaumanni** sp. nov.

Holotype ♂: Brazil; Santa Catarina; Nova Teutonia, September 1955, F. Plaumann (author's collection).

Vertex black, darker laterally and on ocellar tubercle. Three distinct ocelli. Front rufous, darker near vertex. Face, facial grooves, and cheeks yellow, rufous in some areas, blackish in center of grooves. A black mark at the fronto-facial junction which is lower than antennal base, more than usual, due to antennal base being higher than usual. This gives the more quadrate shaped head when viewed from the side. A black line along oral margin. Cheeks more than half of eye-height. Occiput blackish above, dark yellow below, yellowish gray pollinose. Antenna, including arista, black. Medial surface of second antennal segment dark reddish. Basal half of third antennal segment bright rufous. First antennal segment as long as wide. Second segment two times length of first. Third segment two times length of second. Proboscis black, geniculate at middle. Middle segment two times length of head.

Thorax black, brownish pollinose. Dorsum with indistinct dark lines. Legs mainly black, basal half to three-fifths yellow. Anterior surface of anterior femur dark yellowish. Ventral apical margin of anterior and middle femora dark yellow. Tibiae partly yellowish, especially at base and center of posterior tibia. Tarsi partly yellowish. Apical tarsal segment and apical half of claws black. Wings hyaline, faintly brownish along the veins. Stigma at apex of first and second veins yellowish. Anterior cross-vein markedly thickened in the middle. First posterior cell widely opened. Opening slightly longer than anterior cross vein. Calypters pale yellow. Halteres yellow, dark reddish at base of stem.

Abdomen black, yellowish gray pollinose more distinct laterally and along distal margin of each segment. Distal margin of fourth and fifth segments and most of sixth segment dark reddish. Genitalia mainly black.

Size: 5½ mm. (without antenna).

**Stylogaster lopesi**, sp. nov.

Holotype ♀: Brazil: Santa Catarina; Nova Teutonia, Dec. 7, 1949, F. Plaumann (author's collection).

Ocellar triangle shining black, nearly equilateral, and nearly touching the frontal lunule. Front velvety black. Orbitals, face, and cheeks yellowish white pollinose. Facial keel with narrow black line. Occiput black above, gray pollinose laterally and below. Antenna dark yellowish, brighter on inner ventral surface of third segment. Arista black. First antennal segment as long as wide; second segment four times as long as first; third segment as long as second, gradually narrowing apically. Proboscis black, yellowish on apical third of distal segment. Apical segment about three times length of head.

Thorax black, yellowish on humeri and pleura at base of wing. Dark yellowish at posterior calli. Anterior and middle coxae yellowish black, posterior coxa deep black. Trochanters mostly black. Anterior and middle legs yellow except blackish at base of femora, apical tarsi, and claws. Posterior femur black with narrow yellow band just proximal to the middle. Posterior tibiae black with distinct white preapical band, which is entirely white haired. Posterior tarsi and claws black. Wings dusky hyaline, slightly brownish anteriorly. First posterior cell widest at distal third and wider than submarginal cell. Calypters whitish yellow. Halteres yellowish, reddish at apex and base of stem, the club blackish.

Abdomen black, yellowish in two spots at base of first segment and triangular basal sides of remaining segments. These pale areas are largest on third and fourth segments. Hairs on sides of first segment white. Those on second segment mostly white but with some black bristles. Ovipositor mainly black, reddish on narrow first segment, narrow base of second segment, and narrow base of third segment. Third segment white on distal three-fifths, reddish yellow at apex with black genital structures. Ovipositor black haired except for proximal one-half to two-thirds of white area on apical segment.

Size: 16 mm. (without antenna). Ovipositor 7 mm.

Allotype ♂ : Brazil: Nova Teutonia, Oct. 1952, F. Plaumann (author's collection).

Similar to holotype. Sixth and seventh abdominal segments black. Genitalia yellow. Two patches of yellow hairs on dorsum of seventh segment. No black bristles on sides of second segment. Size: 10 mm.

Paratype ♀ : Brazil: Nova Teutonia, Nov. 9, 1951, F. Plaumann (Natural History Museum, Basle, Switzerland).

Similar to holotype. Dark areas somewhat more extensive. Size: 15 mm. Ovipositor 7 mm.

Paratype ♂ : Brazil: Nova Teutonia, Oct. 1954, F. Plaumann (author's collection).

Similar to the allotype. Size 11 mm.

Paratype ♂ : Brazil: Nova Teutonia, Nov. 1950, F. Plaumann (author's collection).

Similar to the allotype. Size 10½ mm.

This species keys to Curran's couplet 7, differing from the alternatives in the female by having the apical segment of the ovipositor black haired proximally and apically, and white haired on about the middle third. In the male, this species differs from the alternatives at couplet 7, by having the basal three-fifths of the posterior tibia entirely black.

Named after H. de Souza Lopes in recognition of his fine work on this genus.

# A SUPPLEMENT TO THE REVISIONS OF THE DACETINE ANT GENERA *ORECTOGNATHUS* AND *ARNOLDIDRIS*, WITH KEYS TO THE SPECIES[1]

By W. L. Brown, Jr.

Museum of Comparative Zoology, Harvard University

The Orectognathiti are a small group of dacetine ants found in the Australopapuan area, grouped into two genera, *Orectognathus* Fr. Smith and *Arnoldidris* Brown. Previous revisions (Brown, 1950, 1953) have recognized nine species in the first and four in the latter genus; of these, I had been able to study directly only six species of *Orectognathus* from satisfactory material and under favorable conditions. Recently, however, I have been able to see additional material collected by E. O. Wilson in New Caledonia and New Guinea, and in eastern Australia by Father C. Mercovich and myself. Furthermore, through the kind help of Curator Elisabetha Bajári of the Hungarian National Museum, I have been loaned the types of *Orectognathus csikii* Szabó, *Arnoldidris biroi* (Szabó), *A. horvathi* (Szabó) and *A. chyzeri* (Emery). During a hurried visit to the British Museum, I saw the type of *Arnoldidris longispinosus* (Donisthorpe), but was unable to make a proper sketch or notes beyond the affirmation of the species as a true *Arnoldidris* of the *biroi* group.

In the present paper, I propose to add two new orectognathite species and to offer notes on the characters, biology and distribution of some older ones. For the sake of a complete treatment and full keys, I have included notes and a figure of the manuscript species as derived from the characterization of (*O. nigriventris*) by Father Mercovich. It may be some time before the formal description of Father Mercovich's species appears in print, and neither he nor I intend that the preliminary informa-

[1] Published with the aid of a grant from the Museum of Comparative Zoology at Harvard College.

tion concerning the species offered here should be considered as constituting publication of (*O. nigriventris*).

The aid of Curator Bajári, Father Mercovich and Dr. Wilson in preparing this supplement is gratefully acknowledged. The abbreviations of measurements and indices, and also of places where specimens are deposited, are as in my other works on the dacetines, including the *Orectognathus* revision (Brown, 1953).

*Arnoldidris biroi* (Szabó)

A single worker taken by Wilson at Wamuki, about 800 m. altitude, Mongi Watershed, Huon Peninsula, New Guinea, agrees well with a type from the Hungarian National Museum. Wilson's worker was taken from a shrub in rain forest, foraging during daylight hours.

*Arnoldidris horvathi* (Szabó)

The type collection of this ant, possibly the most bizarre formicid known, remains the only sample known. The type confirms the figures of Szabó in all important respects.

**Arnoldidris szentivanyi** sp. nov.

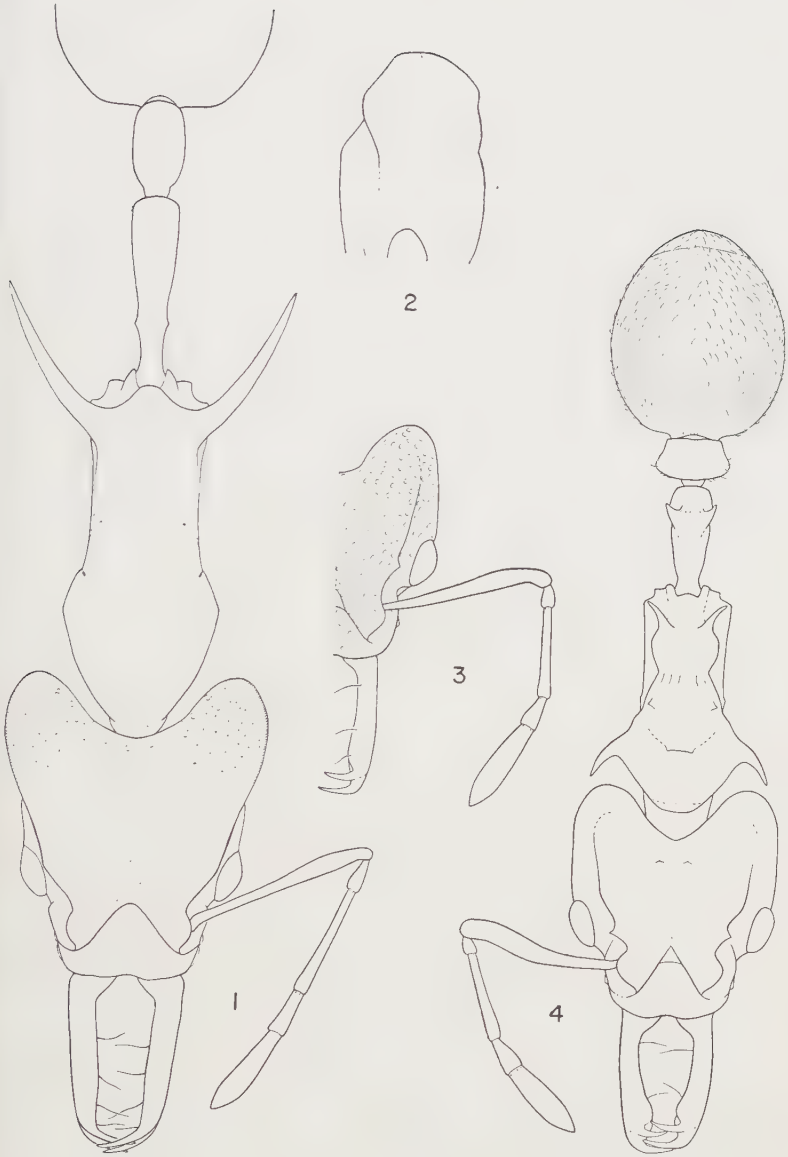
(Figures 1, 2)

Holotype worker: TL 6.1, HL 1.38, HW 1.18 (CI 86), scape L 0.92, max. diameter of eye 0.27, ML 0.80 (MI 58), WI 1.66 (occipital lobes overlap pronotum about 0.17 mm., an amount duly subtracted from TL), petiole L in side view 0.83, postpetiole L 0.35, gaster L 1.25, propodeal spine L 1.12, gaster W 1.02, pronotal W 0.71 mm.

Form as shown for the paratype in Figure 1 and Figure 2. Occipital lobes each bordered dorsolaterally by a round-edged carina, indicated in the figures. Mesepisternum on each side extended as a shallow translucent lobe overlapping the upper posterior part of the fore coxa. Metapleural lobes rounded. Petiole very slender, gently arched,

EXPLANATION OF PLATE 1

Figures 1 to 4. Figure 1, *Arnoldidris szentivanyi* sp. nov., paratype worker, dorsal view. Figure 2, same, side view of posterior half of head. Figure 3, (*Orectognathus nigriventris* Mercovich ms.), worker from type series, dorsal view of half of head. Figure 4, *O. phyllobates* sp. nov., holotype worker, dorsal view. All to same scale. Drawings by Nancy Buffler.




Brown — Arnoldidris and Orectognathus

its anterior peduncle very slightly depressed, the nodal portion approximately circular in cross section.

Body generally smooth and strongly shining; underside of head with strong, crowded but separate foveolae; a few small, inconspicuous foveolae on dorsum of head in zone bordering occipital excision, but most of upper surfaces of occipital lobes with no more than small, widely-spaced punctures. Pubescence and pilosity absent from body generally, except for the sensory setae of labrum and mandibles, the short hairs at gastric apex, and a dilute reclinate pubescence of the antennae, legs and mouthparts, most noticeable toward the extremities.

Color rich medium brownish-red; vertex and a median area just behind clypeus almost imperceptibly shaded; mandibles, antennae, legs and gaster clear yellow; mandibular apices, dorsolateral margins of occipital lobes, propodeal spines and both nodes ferruginous yellow.

The holotype [MCZ] was collected with seven worker and two dealate female paratypes at the village Ebabaang, altitude about 1400 m., in the Mongi Watershed, Huon Peninsula, New Guinea, April 18, 1955 (E. O. Wilson leg.). The seven worker paratypes [MCZ, HNM, USNM]: TL 5.9-6.4, HL 1.31-1.43, HW 1.12-1.23 (CI 85-87), ML 0.74-0.82 (MI 57-58), WL 1.59-1.75 mm. Color of head and alitrunk varies from light to rather dark reddish-brown; infuscation of vertex absent to fairly distinct. Propodeal spines vary slightly in length, angles of elevation and divergence, and in strength of their arch as seen from the side; in some specimens the tips are a little more strongly deflected ventrad than in others.

One of the two dealate females: TL 6.5, HL 1.43, HW 1.28 (CI 90), ML 0.80 (MI 56), WL 1.76 mm. Similar to worker, with the female differences usual for dacetines. Compound eyes only slightly larger than in worker; ocelli small but distinct. Meso- and metanota together forming an abruptly raised dome, smooth and shining, with scattered small punctures. Propodeal spines straight (not gently arched as in worker), only the extreme tips slightly deflected ventrad. Sculpture, color and pilosity as in worker, except that punctures on dorsal surfaces of oc-

cipital lobes are more abundant and larger, more nearly foveoliform. The second female paratype has the propodeal spines very slightly arched as seen in side view, but still straighter than in any of the workers.

Wilson found the first workers (No. 839) foraging on bushes or small trees under 2 m. tall, at about noon on a sunny day, but in deep shade in rain forest. Careful search of the ground litter below the bushes turned up two dealate females and additional workers, indicating that the nest was inadvertently scattered. The workers are very slow and deliberate in their movements, and often stand still in one spot for long periods. One worker was seen walking with gaster recurved under the alitrunk. None was seen with prey, which could have been one of the numerous Collembola seen so commonly on stems and leaves of trees where the ants were taken. In a colony fragment returned to the United States alive, the female and four workers were exceedingly sluggish, and failed entirely to attack some entomobryid collembolans enclosed in a small nest with them in such a way that numerous contacts between springtails and ants were enforced. One egg was laid by the ants, but this disappeared within a few days. The colony appeared to be disorganized, and the adults spent much of their time resting on the glass cover forming the ceiling to their chamber. After two or three weeks, all adults had died.

A single worker labeled "Wisselmeren: Obano," collected at 1770 m. in Netherlands New Guinea by J. L. Gressitt, is slightly larger than the *szentivanyi* type series: TL 5.8, HL 1.44, HW 1.30 (CI 90), ML 0.83 (MI 58), WL 1.73 mm., but is similar in form. Its color is darker: head and alitrunk blackish-piceous; nodes and alitrunk orange or deep ferruginous yellow; legs and antennae ferruginous yellow, mandibles straw yellow. Punctation of head more distinct throughout, especially over the entire dorsal surfaces of occipital lobes, which are covered with spaced, umbilicate foveolae. Whether this specimen belongs to *szentivanyi* and is merely a geographical variant can only be decided by the study of more material.

Key to *Arnoldidris* species, based on workers

1. Each occipital lobe drawn out into a long, dorsally curved, tapered spine ..... *horvathi* (Szabó)
   Occipital lobes rounded or bluntly angulate, not drawn out into acute teeth or spines ..... 2.
2. Propodeal spines and petiole long, but not extremely so, about 3/4 as long as the greatest width of the gaster; color (of type worker) yellow, with blackish alitrunk and nodes ..... *chyzeri* (Emery)
   Propodeal spines and petiole extremely long, about as long as the gaster is wide; color not as above, the head and alitrunk usually darker than the gaster ..... 3.
3. As seen from directly above (full-face view of head), the occipital lobes terminate each in a blunted angle ..... 4.
   As seen from directly above (full-face view of head), the occipital lobes each end in an evenly rounded full curve ..... 5.
4. Head and alitrunk brownish-red, gaster yellow ..... *biroi* (Szabó)
   Head and alitrunk predominantly black or piceous, gaster brownish-yellow ..... *longispinosus* (Donisthorpe)
5. Color of head and alitrunk rich medium brownish-red, gaster yellow; coarse punctures on occiput restricted to the immediate zone along the posterior excision ..... *szentivanyi* Brown
   Color of head and alitrunk predominantly black or piceous, gaster brownish-yellow; coarse punctures or foveolae widely distributed and conspicuous over occipital lobes ..... The specimen from Wisselmeren, discussed under *A. szentivanyi.*

*Orectognathus antennatus* Fr. Smith

Specimens have been received from an additional Australian locality, the collection by Father C. Mercovich: Calga, New South Wales. These specimens average a little smaller than samples previously found: minimum HL 1.31 mm.; CI 75-76, MI 64-65.

*Orectognathus sarasini* Emery

In my *Orectognathus* revision of 1953, I followed Emery in recognizing *O. sarasini* as a distinct species, although it seemed from the original description that there was not much difference from *antennatus*. Wilson has now taken good series referable to *sarasini* in different localities in the southern half of New Caledonia. The material is divided between two distinct color forms, which, however, have the same measurements and the same general structure: TL 4.2-5.3, HL 1.07-1.26, HW 0.81-1.00 (CI 76-79), ML 0.64-0.71 (MI 59-60), WL 1.12-1.31 mm. (workers). A female from series No. 115 measures: TL 5.6, HL 1.24, HW 1.04 (CI 84), ML 0.69 (MI 56), WL 1.40. A male measures: TL 3.7, HL 0.69, HW 0.74, WL 1.26 mm. (Series No. 115).

This species is like *O. antennatus*, from which it differs only by the minor features cited in the key; the greater development of the humeral and anterior mesonotal protuberances is a relative character, difficult to appreciate without comparison direct of material of both forms. As Wheeler suggested, it is entirely possible that *antennatus* and *sarasini* are conspecific, but in the absence of objective criteria for their true relationship, it seems best to continue to distinguish them as arbitrary species, especially in view of the possible complications next discussed.

Emery described *O. sarasini* from Mt. Canala, New Caledonia. Wilson has seen type material, and affirms that it corresponds to a color form that he took, not at Canala, but at Mt. Mou and Le Chapeau Gendarme, which is concolorous clear ferruginous yellow, with only the legs lighter yellow (Mt. Mou: Nos. 115, 141; Le Chapeau Gendarme, No. 91 and Berlese samples). At and around Ciu, on the approaches to Mt. Canala, Wilson collected several series at about 300 m. altitude (Nos. 251, 289, observation colonies CC and EE, berlesates) in which the color of the workers is strikingly different: the color differs from that of *sarasini* in that the alitrunk and dorsum and sides of the head (except occipital lobes and sides of clypeus) are piceous, appearing black to the

naked eye. The remaining parts are ferruginous yellow, although the gula and both nodes are slightly tinged with brownish. The female is colored much like the worker.

The male of *sarasini* is like the *antennatus* male, but is smaller and with proportionately narrower gaster; the surface of the gaster, while variable, tends to be much more smooth and shining; pubescence of gaster much reduced, less even than in *antennatus*.

The question arises as to whether the black-and-yellow form truly belongs to *sarasini*, or is a different species; this question can be answered only by a more intensive study of the distributions of the two types of color pattern. It is interesting to speculate that the original Canala concolorous population may have changed, in a period of four or five decades, to a bicolorous condition. Rapid changes of this type are not unknown in other animal groups (e. g., snails of the genus *Partula*, Crampton, 1917, 1932) that occur in insular situations.

Of the Mt. Mou collections of the concolorous yellow form, No. 115 was a small colony in a cavity about 3 cm. across under a small rock in wet soil by a stream, altitude between 180 and 400 m. The colony had a single queen and brood. No. 141 consisted of workers taken foraging on the trunks of two trees growing close together in dry forest; the collection was made during the first two hours of darkness and at a height of from 1-2 m. above the ground. The same spot was visited during daylight hours, but no further specimens were found. At Le Chapeau Gendarme, No. 91 was a nest in a rather dry dead branch, about 7 cm. in diameter, lying on the ground amid dry, thin leaf litter. This colony was observed for a short time in the artificial nest, but during that time it did not feed on any of the collembolans or other small arthropods that were provided. At this locality, stray workers were also taken in leaf litter berlesates.

At Ciu, No. 251 was a colony of about 30 workers, a single dealate female, 3 males, and 20-30 larvae and pupae gathered in a small circular cavity about 4 cm. wide in thin soil collected between two large rocks on the floor of rain forest. No. 289 was a colony taken under a rock

in a drier, more open part of the forest. Other samples from Ciu came from soil cover berlesates.

**Orectognathus phyllobates** sp. nov.

(Figure 4)

Holotype worker: TL 4.5, HL 1.12, HW (disregarding compound eyes) 0.97 (CI 87), scape L 0.78, greatest diameter of eye 0.24, ML 0.64 (MI 57), WL 1.14 (occipital lobes overlap pronotum by about 0.12 mm., an amount subtracted from WL to obtain TL), petiole L in side view 0.47, postpetiole L 0.22, gaster L 1.00, propodeal spine L 0.28 mm.

Form as shown in Figure 4. Occipital lobes concave inside the bluntly carinate continuations of the frontal carinae: vertex convex, bituberculate centrally. Maximum depth of head about 2 3 HL. Anteocular teeth well developed, acute and sharply elevated. Mandibles strongly concave inside, even more so than in (*O. nigriventris*), the heavy preapical convexities correspondingly stronger. The three apical teeth subequal in length; upper tooth diverging from the lower pair as seen in end-on view of mandible.

Alitrunk in the typical *Orectognathus* plan; pronotum depressed and marginate, with a pair of strong, acute, anteriorly curved teeth, incrassate basally; rear of pronotum sloping through a gradual curve up to the mesonotum. Mesonotum raised in the usual manner; anterior tubercles low, blunt; posterior pair higher, more dentiform, though with extreme tips blunt. Propodeal spines strongly elevated, approximately straight in side view, diverging and slightly outcurved in dorsal view. Petiolar teeth strong, acute, curving posterodorsad, but with apices deflected. Postpetiole subtrapezoidal in dorsal view (Figure 4) ; in side view semiglobose in outline.

Body generally smooth and shining, with widely scattered inconspicuous punctulae in some areas. Sides of posterior alitrunk with some rather irregular rugosity; metanotal groove with short longitudinal costulae; costulae at base of gaster very short, almost obsolete, confined

to the basal ring or groove. Funiculi and tarsi finely and densely punctulate, subopaque. Most dorsal surfaces of body, including humeral teeth, pronotum and sides of head, with a fairly abundant but short, fine and inconspicuous pilosity, mostly arched-subappressed, but becoming curved-erect on mesonotum. In Figure 4, only the pilosity of postpetiole and gaster is depicted; the gastric pilosity, in the form of a conspicuous whitish decumbent pubescence, is very even, evenly spaced, and quite distinctive. On legs and antennae, a dilute oblique pilosity becomes shorter and denser as a pubescence apicad.

Head, alitrunk and both nodes piceous brown (with a hint of reddish that may be due to fading), gaster deep piceous, nearly black. The general body color appears approximately black in life. Mandibles and antennae yellowish-brown, basal 2/3 of mandibles and middle of scape tending more toward light yellowish. Legs brown, with conspicuous broad bands of light straw color occupying the basal third of each of the six femora and the middle third of each of the two anterior tibiae.

The holotype [MCZ] and only known species of *O. phyllobates* was taken at the edge of the ravine which constitutes Joalah National Park, near the top of Tamborine Mt., southeastern Queensland. The ant was taken in late afternoon from the foliage of a glossy-leaved woody plant, a shrub or young tree, about three feet above the ground. The plant was growing in a very small opening in rain forest, the result of the falling of a medium-sized tree from the canopy. Intensive search was made of the ground cover near the plant, but no indication of the nest could be found.

*O. phyllobates* is most closely related to (*O. nigriventris*), but is easily distinguished by means of its broader postpetiole, by its smooth, shining, afoveolate sculpture, by its darker color, by its slightly stronger gastric pubescence, its more concave inner mandibular borders, and other minor details. *O. sexspinosus* Forel is lighter in color and is generally more slender, with much longer teeth or spines on the alitrunk, and it has no teeth on the petiolar node.

The discovery of *phyllobates* on foliage well above the ground, and Wilson's observations on *O. sarasini* climbing treetrunks at night, tend to show that *Orectognathus* may be more or less generally a nocturnal, arboreal or subarboreal forager. That *O. clarki* Brown may have similar habits seems likely, in view of the fact that this species is never seen foraging outside the nest during the daytime (so far as limited observations go).

Key to *Orectognathus* species, based on workers

1. Each occipital lobe drawn out as a stout, acute, dorsally curving tooth (n. Queensland) ..... *satan* Brown
   Occipital lobes bluntly rounded posteriorly, without teeth ..... 2.
2. Propodeal spines about 3 times as long as the distance between the centers of their bases; body and limbs with abundant, generally-distributed, fine, short, erect pilosity; petiolar node very slender, unarmed. (Queensland) ..... *sexspinosus* Forel
   Propodeal spines markedly less than 3 times as long as the distance between the centers of their bases; either the body without generally-distributed pilosity, or else the petiolar node bidentate, or both ..... 3.
3. Inner mandibular border just basad of apical teeth with a small tooth or dentiform angle, acute to subacute at tip ..... 4.
   Inner mandibular border without an acute or subacute tooth or toothlike angle in the region just basad of the apical teeth, though some species have a rounded flange or thickening in this region ..... 5.
4. Paired anteocular teeth, and a pair each on the vertex and petiolar summit, developed and acute; erect pilosity present and generally distributed over body (New Guinea) ..... *csikii* Szabó
   Anteocular teeth and teeth of vertex obsolete, petiolar teeth nearly so; erect hairs confined to mandibles, under-mouthparts and gastric apex (Lord Howe I.) ..... *howensis* Wheeler
5. Anteocular teeth lacking or represented only by an obtuse angle on each frontal carina; head narrower, CI normally 75-80 in the worker ..... 6.

Anteocular teeth developed and normally strong, acute or at least rectangular; head averaging broader, CI 79-97, only rarely less than 81 ..... 8.

6. Lamellate margin of inner mandibular border narrow throughout, not or scarcely expanded near the apical teeth (Queensland) ..... *mjobergi* Forel
Lamellate margin of inner mandibular border with a distinct, rounded, subapical expansion or flange .. 7.

7. Size smaller, head length (HL) less than 1.30 mm.; pronotal teeth larger and blunter; anterior mesonotal tubercles well developed (New Caledonia) ..... *sarasini* Emery
Size larger, head length (HL) 1.30 or more; pronotal teeth smaller and more acute; anterior mesonotal tubercles poorly developed (s. e. Australia; North I., N. Z.) ..... *antennatus* Fr. Smith

8. Dorsal surface of head smooth and shining, with minute punctures or small, spaced foveolae; dorsal surface of gaster with a fine but distinct, more or less reclinate, pubescence-like pilosity ..... 9.
Dorsal surface of head covered with coarse, crowded and often contiguous foveolae, the integument consequently subopaque to opaque; dorsal surface of gaster with only an extremely fine and dilute, appressed, pubescence-like pilosity (workers more or less polymorphic) ..... 10.

9. Dorsal surface of head smooth and shining, with only the most minute and inconspicuous of punctulae; postpetiole at least 1½ times as broad as long, much broader anteriorly than behind (Figure 4) (s. Queensland) ..... *phyllobates* Brown
Dorsal surface of head smooth and shining, but sown with numerous circular, umbilicate foveolae (Figure 3); postpetiole only slightly broader than long, with convex sides, not or scarcely broader in front than behind (e. New South Wales) ..... (*nigriventris* Mercovich ms.)

10. Inner mandibular borders approximately straight along basal 2/3; polymorphism of workers extending

to a very large-headed, broad-jawed soldier form in addition to more "normal" workers (e. New South Wales, s.e. Queensland) ..... *versicolor* Donisthorpe
Inner mandibular borders shallowly but distinctly concave along basal 2/3; worker polymorphism not extending to the extreme large-headed, broad-jawed soldier form (Tasmania, s. Victoria to mts. of s.e. Queensland) ..... *clarki* Brown

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# REPRODUCTIVE ISOLATION IN THE HOUSE CRICKET (ORTHOPTERA: GRYLLIDAE)[1]

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The existence of considerable geographic variation in the morphology of the field cricket, *Acheta assimilis* Fab., in North America has caused much confusion in its taxonomy, and although the variants are now commonly grouped into one species, the work of Fulton (1952) has shown that this solution is no longer acceptable. Fulton found that four "physiological races" of this insect which are reproductively isolated exist in North Carolina, and that although they show some average structural differences, intergradation between the races prevents the identification of specimens on morphological grounds.

The house cricket, *Acheta domesticus* (Linn.), is an insect with a cosmopolitan distribution but, surprisingly, has been the subject of very little work, although its availability and ease of rearing should have favoured its use as a laboratory animal. In the course of a study on the physiology of the development of this insect (Ghouri and McFarlane, in preparation), we have compared a strain obtained from Pakistan, where it lives in the field, with one obtained in Canada and have found rather large differences in their rates of development, among other characteristics, although morphologically they are quite similar. This report is concerned with the results of crossing ex-

[1] This paper is based on a thesis submitted to McGill University by A. S. K. Ghouri in partial fulfillment of the requirements for the Ph.D. degree.

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periments between the two strains which show that they are reproductively isolated.

## Methods

Eggs of the "Pakistani" strain were obtained from females collected near Usta Mohammad, West Pakistan, and sent to us by the Department of Plant Protection, Government of Pakistan, Karachi.[3] The "Canadian" strain was collected from the basements of Macdonald College. Dr. A. B. Gurney of the U.S. National Museum, Washington, D.C., very kindly confirmed the writers' identifications.

Virgin females were obtained by segregating the sexes as soon as the ovipositors could be detected in the hoppers. Single pairs were kept in two-pound ointment jars and groups of two or more pairs in one-gallon candy jars.

Crossing experiments were laid according to the plans shown in Tables I and II. Oviposition dishes containing moist sand were provided after 4 to 5 days and thereafter on alternate days until the female died. All eggs laid by each female were counted and incubated. The spermathecae of a number of females were examined for sperms at various intervals ranging up to two months after the experiments were begun.

## Observations

The results of the crossing experiments are shown in Table I. The number of eggs laid in crosses within a strain, as shown in the table, does not represent the total egg production of the females, but only the number of eggs examined in order to establish that development was taking place.

The eggs laid in crosses between individuals of the same strain and in the stock cultures usually hatched, whereas eggs laid in crosses between the strains invariably failed to develop and died 4 to 6 days after incubation. The spermathecae of 9 females in the latter crosses, examined at different intervals during the active oviposition period of stock females of similar age, were devoid of sperms,

[3] We are grateful to the Department of Plant Protection for supplying eggs of the Pakistani strain.

TABLE I — Crossing experiments with normal insects.

| Code No. | Cross | No. Eggs Laid | No. Eggs Developing | No. Females Examined | Sperms Found (+) in Spermatheca, or Not Found (—) |
|---|---|---|---|---|---|
| X19 | 2 Pak. X 2 Can. | 0 | 0 | | |
| X13 | 2 Pak. X 2 Can. | 740 | 0 | 1 | — |
| X18 | 3 Pak. X 2 Can. | few | 0 | 1 | — |
| X55 | Pak. X Can. | 0 | 0 | 1 | — |
| X70 | Pak. X Can. | 25 | 0 | 1 | — |
| X12 | 5 Can. X 3 Pak. | few | 0 | 4 | — |
| X22 | 2 Can. X 3 Pak. | 3 | 0 | 1 | — |
| X23 | 2 Can. X 2 Pak. | 0 | 0 | | |
| X21 | Can. X Pak. | 0 | 0 | 1 | — |
| X48 | Can. X Pak. | 2 | 0 | 1 | — |
| X52 | Can. X Pak. | 0 | 0 | 1 | — |
| X70 | Can. X Pak. | 99 | 0 | 1 | — |
| Stock | Pak. X Pak. | Produced several | | 3 | + |
| Stock | Can. X Can. | hundred offspring | | 4 | + |
| X50 | Can. X Can. | 641 | 641 | | |
| X61 | Can. X Can. | 471 | 471 | | |
| X65 | Can. X Can. | 324 | 324 | | |
| X35 | Pak. X Pak. | 94 | 94 | | |
| X36 | Pak. X Pak. | 38 | 38 | | |
| X38 | Pak. X Pak. | 116 | 116 | | |

whereas the spermathecae of females in the former crosses invariably contained sperms.

Although the ovaries of females in the crosses between the strains were apparently normal, containing large numbers of eggs, these females laid a smaller number of eggs than did the females mated with males of the same strain. A female of the Canadian strain generally withheld her eggs until the last days of her life. On the other hand, Pakistani strain females mated to Canadian strain males laid eggs comparatively earlier than the Pakistani females mated to Pakistani males.

Individuals of the two strains are not separable by any consistent structural differences (their morphology has, however, been far from adequately studied, and it is quite possible that obvious differences do exist); however, the strains may still be distinguished by average differences in appearance and behaviour. The average size of the body, ovipositor, the genital openings and spermatophores of the Canadian strain adults are larger than those of the Pakistani strain. The color of the Pakistani strain adults varies from light brown with distinct markings on the head to very dark brown with scarcely perceptible markings, whereas the adults of the Canadian strain are generally light brown and do not show as much variation (both light and dark Pakistani adults were used in the crosses). Individuals of the Canadian strain are docile and seldom take to wing; on the other hand, adults of the Pakistani strain are comparatively active, and have been observed to fly as many as 50 yards at a stretch.

In spite of the mating sounds and courtship of the males (as described by Khalifa, 1950), neither the Pakistani nor the Canadian strain females showed interest in the males of the other strain. In the crosses, females of the Canadian strain often devoured the smaller males of the Pakistani strain.

### Effect of removal of tegmina of males

The stridulation of the male cricket has commonly been considered to be important in attracting the females.

Species differences in the sounds made by the male are frequently detectable by the human ear, and Fulton (1952)

TABLE II—Crossing experiments after removal of the tegmina of the males at the base, wings left intact.

| Code No. | Cross | Eggs Developed (+) or Failed to Develop (—) | Sperms Found (+) in Spermatheca or Not Found (—) |
|---|---|---|---|
| C1 | Canadian X Canadian | | + |
| C2 | Canadian X Canadian | + | |
| C3 | Canadian X Pakistani | — | |
| C4 | Canadian X Pakistani | | — |
| C5 | Pakistani X Canadian | — | |
| C6 | Pakistani X Canadian | — | |
| C7 | Pakistani X Pakistani | + | |

has characterized one of his races of the field cricket on the basis of its song. It seemed possible that the mating sounds of the male were responsible for the unattractiveness of the males to the females of the other strain of *A. domesticus*, although no differences between the strains were apparent. The tegmina of the males of both strains were accordingly severed at the base, leaving the wings intact (the removal of the tegmina did not appear to affect the normal activities of the males), and crossing experiments were carried out as shown in Table II.

Females mated with males of the same strain laid fertilized eggs and the spermatheca of one female was found to contain sperms, whereas females mated with males of the other strain laid eggs which invariably failed to develop, and no sperms were found in the spermatheca of the one female examined. Thus the stridulation of the participating male is not necessary for copulation (or, more precisely, insemination), nor is it the sole discouragement to copulation in crosses between strains.

## Discussion

These crossing experiments have shown that the Pakistani and Canadian strains of *A. domesticus* are reproductively isolated, and therefore are actually separate species, as defined biologically (Mayr *et al.*, 1953).

In his crossing experiments with the races of *A. assimilis*, Fulton (1952) found that while insemination always took place, eggs laid by the females invariably failed to hatch. He concluded that hybrids were not produced either because the eggs were not fertilized or because the zygotes were not viable. With the two strains of *A. domesticus*, however, reproductive isolation consists in a failure of insemination to take place. It is possible that the strains of *A. domesticus* are not isolated at the genetic level or at the level of fertilization that separates the races of *A. assimilis;* however, attempts to achieve artificial insemination or fertilization have not been successful, due to technical difficulties.

Although there can be little doubt that geographic isolation has led to the differences between the Pakistani and Canadian strains, it would be of interest to discover the mechanism which is responsible for their isolation when brought together. Behavioural differences, in the broad sense, are obviously involved, and these may have to do with actions during courtship or perhaps with the odour of the male. In *A. assimilis*, Fulton (1952) has found that two "races" may occupy the same habitat, and the possibility that a more intensive study of both species groups will show that geographic isolation is not essential in speciation makes a study of the mechanism of isolation very much worthwhile.

The Pakistani and Canadian "strains" of *A. domesticus* are two distinct species, but, as has been pointed out by Gurney (1951) and Hubbell (1956) for *A. assimilis*, no practical purpose will be served, at the present stage of our knowledge of these crickets, by creating a new specific name. It will be desirable, however, to maintain a distinction between the species by giving each a geographic designation.

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